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SCOTT TURNER, DIRECTOR

INFORMATION CIRCULAR

SAFETY AT THE OLD DOMINION COPPER MINE, GLOBE, ARIZ.

BY

R. I. C. MANNING AND ALBERT TALLON

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SAFETY AT THE OLD DOMINION COPPER MINE, GLOBE, ARIZ.[1]

By R. I. C. Manning[2] and Albert Tallon[3]

The Old Dominion Co. at Globe, Ariz., like the Phelps Dodge Corporation with which it is closely allied, considers safety a major operating problem. Safety is fostered by this company in consideration of both the humanitarian and economic aspects; the officials take pride in promoting the welfare of employees, and the management has found that the safest way is the most economical and that unless an organization is operated economically it can not continue to exist successfully.

In planning and operating any safety organization, many things must be taken into consideration because an enterprise can not be operated solely for safety any more than it can for any other single part of the operations. All work must be planned and executed for the common interest.

In studying a safety organization and the results obtained by it, some knowledge of the conditions prevailing prior to its existence is necessary as well as a complete understanding of the present conditions under which it has to operate. Therefore, in perusing this report, it will be well for the reader to keep in mind certain handicaps existing at the Old Dominion mine, which are:

High rock temperatures.
High humidity.
High air temperatures.
Wide variance in stoping methods, brought about by various grades and conditions of ore deposits, making standardization difficult.

The following paragraphs regarding temperatures and humidity are taken from "Ventilation of the Large Copper Mines of Arizona," United States Bureau of Mines Bulletin 330, by G. E. McElroy, 1931.

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United States Weather Bureau records for Globe, covering 26 years, show an average yearly mean dry-bulb temperature of 63.5°. No relative humidity or wet-bulb temperature data are available, but low humidities prevail and wet-bulb temperatures average about 15° lower than dry-bulb temperatures. These high average temperatures and high rock temperatures make the ventilation of the mine a difficult problem.

The range of temperatures at working places is wide and depends primarily upon the proximity of the working places to downcast shafts. Stope temperatures range from 70 to 90° dry bulb, with an average of about 80° accompanied by an average wet bulb depression of about 5°. Development faces are, as a rule, somewhat warmer, 80 to 95°, with only 2 to 3° wet bulb depression, but they have greater air motion than stopes and are comparable in comfort. Practically all places off the intake air courses are uncomfortably warm, the maximum condition of discomfort noted being on the 2600 level development drift off the A shaft where the air returning to the shaft at a velocity of 250 feet per minute was saturated at 102° F. Rock temperatures at the face of this drift were 108.5°.

PROPERTY

The Old Dominion property is at Globe, Gila County, Ariz., and consists of a mine, concentrator, and the necessary shops pertaining thereto. This copper mine is relatively deep, and operates on a series of steeply dipping parallel fissure veins which cut sedimentary limestones and quartzites intruded by diabase and covered with dacite. The mine is divided into the east and west sides. On the east, fairly regular bodies of sulphide ore predominate, whereas on the west the ore occurs as irregular bodies of oxidized and secondary ores cut by numerous faults. The average dip of the veins is 80° from the horizontal, and the strike east and west. The principal ores are chalcopyrite, chalcocite, and bornite with low-grade sulphides. Copper ore was first mined in this district in 1881.

For complete information on the geology and history of this mine see "Geology of the Globe Copper District, Arizona," United States Geological Survey Professional Paper 12, by F. L. Ransome, 1903. The ore production for December, 1930, was 40,000 tons averaging 2 per cent copper, and was mined by an underground force of 625 men.

The mine is opened by five vertical shafts -- namely, A, K, Grey, Pump, and C.

Operations are carried on through the A shaft, consisting of five compartments -- one for water pipe, two for handling men and supplies, and two for skips. A single-deck cage is permanently secured under each skip, and at the time the shift is changed, double-deck cages are fastened under these cages; thus, there are four triple-deck cages, with a capacity of nine men to a deck, available for handling the shift of men.

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The other shafts are for ventilation and emergency exits. Ladders are installed vertically with platforms at every 20 feet.

Haulage levels are run at approximately 200-foot intervals, vertically. Intermediate levels for mining are run about midway between the haulage levels. There is no uniformity for spacing of raises, as requirements for different mining systems vary greatly.

Five methods of stoping are used at present: Rill, top slice, Morenci slice (modified), square-set, and shrinkage. The size of the orebody, the character of the hanging wall and footwall, the mineral content, and other factors determine the method of mining to be used. About 60 per cent of the extraction is by the modified Morenci slice-caving system.

The mine is ventilated on the pressure system by three fans each of 125,000 cubic feet per minute capacity, each delivering about 80,000 cubic feet of air per minute per fan, at present, at the top of the C, K, and Grey shafts. These fans are aided by large natural-draft pressures and booster fans underground. The principal return air courses are the A and Pump shafts and one compartment of the K shaft. The Pump shaft, which is used for ventilation and pipe lines, is vertical and is 100 feet west of A shaft.

The main fans are forward-curved, multiblade centrifugals. Those at the C and Grey shafts have housings for reversing the direction of air flow.

The air flow underground is approximately 760 cubic feet per minute per man.

For complete description of mining methods at this mine see "Mining Methods at the Old Dominion Mine, Globe, Arizona," United States Bureau of Mines Information Circular 6237, by A. H. Shoemaker, 1930.

Compressed air is blown for one hour in all headings after blasting, before anyone is allowed to enter.

HISTORY OF SAFETY DEPARTMENT PRIOR TO 1925

On January 1, 1914, the mine safety department was inaugurated by placing a safety inspector in the mine for the purpose of preventing accidents, his time being devoted to underground work only.

His duty was to make a regular inspection of and report on the condition of all travel ways, main exits, manways, shafts, and such other places as were used for emergency ways not frequently visited by others; to inspect all working places; to have the necessary precautions taken in all working places to avoid any accidents, and make a monthly report of the conditions found. In case of a serious or fatal accident, either day or night shift, he was notified and visited the place as soon as possible; made a thorough inspection of the conditions; collected all available information by getting the names of all the witnesses and a statement from each one regarding all conditions, so as to be able to make a full report of the accident.

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At that time, as well as at all other times, it was necessary for the officials to take the lead in this movement if adequate results were to be secured. Warning and danger signs were posted throughout the mine; considerable work was done in guarding the tops of chutes and manways to prevent men from falling into them, heretofore the cause of many serious and fatal accidents. In most of the square-set manways staggered ladders were installed, and where the ladders were not staggered, trapdoors were placed. Trapdoors were also installed in all cribbed manways, the distance between them not exceeding 20 feet. All working raises, shafts, and winzes at the height or depth of 50 feet were supplied with blasting batteries, or switches connected to the electric-light wires, and delay-action fuses. Considerable improvements were also in safety conditions around the underground machinery.

To make this movement more successful, it was deemed best to interest the shift bosses by explaining to them that improved conditions meant better work and by making it clear to them that they could perform no better service than that of trying to show an indifferent companion his duty in performing his work in a systematic and intelligent manner, understanding that he had to use his brains as well as his muscles, and recognizing the responsibility placed upon him which he must assume.

To accomplish some of these objects, a system of bonuses for the shift bosses, based on their safety record, was inaugurated. Each shift boss working 500 shifts or more per month without any lost-time accidents was given a bonus of $10. If there was any lost time and it was less than 1 per cent of the total shifts worked, a bonus of $5 was given. This proved successful, as it encouraged them to supervise their men more closely. Every shift boss was entitled to this bonus each month, regardless of the number of accidents in the previous month. In this way they all started out with a clean sheet at the beginning of each month. There was also a form compiled each month with their names, number of accidents, lost time, and other items. This made them more careful because they did not care to see their names with a large number of accidents opposite them.

To get the men interested in the movement it was decided that three men should spend two days each in going through the mine with the inspector. After the first three men had gone through with the inspector for two days, they went back to their respective places, and three more were taken. They were shown the different workings of the mine and the conditions which should be maintained. Conditions were shown that would influence them to use their best judgment in keeping their own places clean and safe and to try to prevent their fellow workmen from being careless.

While going through the mine they were invited to offer suggestions, call attention to anything they deemed necessary to prevent an accident, and ask questions. They were also encouraged to offer suggestions to their bosses whenever they deemed it advisable and to report to them anything they considered dangerous. The bosses were also instructed to be courteous whenever any suggestions were being offered. This proved successful in educating both the bosses and men in safety. Some of the men upon going back would tell their bosses of the improved safety conditions in other runs, and as the bosses were keen to keep their runs at least as good as the others, they

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became active in improving safety conditions. In most cases the men who had gone through were also careful to keep their own working places in good order so that the men following them could not find any fault with their work pertaining to safety. After several hundred had received this safety training the men thought it best to have all the runs represented at the same time in the form of a committee, and recommended that this be adopted: the officials adopted the recommendation, which was the beginning of the present committee system.

In the month of April, 1916, all of the surface plant was added to the safety department under the same inspector. This work began similarly to the underground work by talking safety to the bosses and men to win their confidence and get them interested in the movement. Many improvements were made by placing guards around machinery, removing exposed set screws and keys, and installing new runways for oiling purposes, putting handrails on old runways without them, and making other improvements. Later, the foremen of the various departments decided to select one of their own men each month to make an inspection of their department and report conditions, and to send a copy of the report to the inspector; this plan was continued until the present system of committees was organized.

The present system was organized and the first meetings were held in February, 1925. The organization was divided into two divisions, underground and surface, each division having a central committee and a workmen's committee. At a special meeting of all the superintendents and foremen the surface central committee of 9 members was chosen, and also the underground central committee, consisting of the superintendent and all the foremen. The surface workmen's committee is composed of a representative from each department, and the underground committee of a representative from each boss working 10 or more men. The workmen's committees were appointed by the safety inspector after a careful canvas of the employees to ascertain whom they would prefer to represent them, with the understanding that retiring committeemen, after serving a 6-month term, would elect their own successors.

Meetings are held each month and the minutes of the workmen's committee are read to the central committee at their regular meeting, when the recommendations are considered. The minutes of the central committee are also read at the workmen's meetings so that they will have an understanding of the actions taken on their recommendations.

Since this system was organized a few changes have been made to stimulate a greater interest in the work. It is the duty of the underground workmen's committee to make a weekly inspection trip through their respective runs, to notify their shift bosses of the conditions found, and to make a written report to the inspector. While making their inspection trips they found such a great difference between the men who had served on the committee and those who had not that they deemed it advisable to reduce the term to 3 instead of 6 months, to get the men through quicker so they will all have an understanding of what the safety department is doing for them. This change has been made, and it is now in effect.

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To stimulate the interest among the foremen and bosses, the surface central committee has included all superintendents and foremen as members, with an invitation to all shift bosses to attend all meetings when convenient, and the underground central committee has included all shift bosses as members. The safety department is now represented by 78 members.

Accidents require special study. A repetition of similar accidents indicates that the underlying causes have not been studied thoroughly nor the correct action taken. It is the duty of the workmen's committee to investigate and report on all time-lost accidents. To assist in making these reports and to encourage a thorough inspection, the committeemen are supplied with a special accident report blank, which is filled out by them and delivered to the safety inspector.

At the first meeting of each new committee it is customary to have some of the officials present, who express the feeling of gratitude of the company for the support of the workmen toward this movement. This encourages the committeemen and makes them feel that they have the support of the management which seems to give additional zest to the work on which they are entering. A chairman and a vice-chairman is elected from the floor to serve throughout the term, with the inspector acting as secretary.

At first the recommendations started to come rapidly, and continued to do so for some time. Recently both the underground and surface committees were asked why there were so few recommendations coming in at present. Practically the same reply came from both parties that their boss wouldn't give them any chance. As soon as the boss is told about anything, the work is done and there is nothing to report. This was gratifying to the safety department, and it is hoped that it will continue. This attitude shows that the safety education is spreading and more interest is being taken in the movement. In addition to the list of recommendations recorded, many suggestions have been made by the workmen's committees whereby special investigating committees have been appointed and the work done before the next meeting; hence the matter never went before the central committees; also, the same results have taken place at the central committees' meetings.

Several of the recommendations presented by the workmen's committees were considered too great an undertaking for the central committees, and a special committee was appointed to take the matter up with the general manager, and the work then completed. Also, a number of recommendations have been mentioned to the bosses which they considered to involve too great an undertaking, and advised the committeemen to bring it up at the safety committee meetings. Some of the big jobs would probably not have been done until someone was injured, if it were not for the cooperation displayed at these meetings. The value of these recommendations is apparent when we consider that from February, 1917, to September, 1920, the workmen's committees presented 288 recommendations of which 284 were adopted and the work completed. In addition to aiding safety, it has been proved to the central committees that many of the recommendations materially increased working efficiency. Except for a few changes, this system was in force until March, 1925.

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PRESENT SAFETY ORGANIZATION

On March 14, 1925, the safety department was reorganized and a system installed similar to that of the Phelps Dodge Corporation.

Attitude Toward Safety

The idea that safety is an integral part of the operating activities of this property is impressed on every employee from the manager down. The safest way is considered the practical and most economical way of doing any job. This attitude is taken in regard to routine as well as to new projects.

The management has assured itself that every boss is an enthusiastic booster for safety first, for it believes that discipline and instruction starting at the top are paramount in initiating and maintaining a good safety record. Workmen can best be reached by their immediate superiors, and these men are the real backbone of safety.

That the management is in earnest when it states that accident prevention must come first has been impressed on all local operating officials; safety and efficiency go hand in hand and are inseparable.

Meetings, literature, safety bonuses (for bosses), competition, and instruction are used by the company as effective means of impressing the ideas of safety on the bosses and men. Special talks at underground meetings are given by bosses and men, and each employee is made to feel that he is an integral part of the meeting.

That everything must be done in a safe manner and that safety must not be sacrificed for speed is taught to all the men.

Work of the Safety Engineer

The safety engineer devotes his entire time to safety work and cooperates with all departments, both on the surface and underground. He usually spends the mornings underground and the afternoons on the surface making plant inspections or writing reports.

All safety work comes under his direct supervision, and he reports only to the manager. He meets with all safety committees and acts as secretary. The testing of safety devices also comes under his supervision and all men entering the employ of the company are trained and examined in first aid and various phases of safe work, regardless of their official capacity.

Committees

All safety work is brought up before a committee for discussion. Each branch or division has its own committee, in addition to which there are several committees whose work pertains to the company as a whole.

The Old Dominion Co. is a subsidiary of the Phelps Dodge Corporation, and the corporation committee of this corporation is at the head of all local

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committees. This company also competes for the Phelps Dodge Safety Trophies which are awarded annually to the division having the best safety record in frequency and severity.

Corporation Committee.

Chairman, P. G. Beckett, vice-president and general manager in charge of operations.

Members: Branch managers.

This committee meets quarterly at the various branches in order. (Bisbee, Globe, and Morenci, Ariz.; Nacozari, Mexico; Dawson, N. Mex.)

Branch Committee or General Safety Committee:

Chairman: Manager.

Secretary: Safety engineer.

Members: Heads of departments.

This committee meets once a month in the manager's office to discuss the general safety work and means of obtaining the fullest cooperation of the various departments to prevent accidents.

Bosses Committee:

Chairman: Elected annually.

Secretary: Safety engineer.

Members: All bosses in both surface and underground departments.

Meetings are held monthly to discuss various phases of safety throughout the plant.

Department Committees (two underground, three on surface):

Mine Committee - East side.

Chairman: General mine foreman.

Secretary: Safety engineer.

Members: Division foreman and three workmen. The three workmen serve three months, after which new members are chosen.

Mine Committee - West side.

Same as east side.

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Mine Surface Committee.

Chairman: Mine superintendent.

Secretary: Safety engineer.

Members: Three workmen. Members serve three months.

Concentrator Committee:

Chairman: Concentrator superintendent.

Secretary: Safety engineer.

Members: Three workmen. Members serve three months.

Miscellaneous Surface Committee:

Chairman: Mechanical superintendent.

Secretary: Safety engineer.

Members: Three workmen. Members serve three months.

The secretary of all committees is the safety inspector, who serves permanently.

Workmen members of committees are appointed by the chairman in consultation with the safety inspector, and serve for a period of three months.

All committees meet once a month and make a monthly inspection of the part of the plant they cover.

The department committees have authority to pass on all safety questions in their respective departments, and proceed as soon as possible to carry out any safety provision. Delay is not only dangerous, but causes the men to lose interest. Workmen members are consulted freely and urged to give their ideas, and other workmen on the plant are asked to call to the attention of the committee any dangerous condition. Questions which involve a heavy expenditure or affect the general policy of the company are referred at once to the general committee for prompt action. When the representatives of the management on the committees and the workmen can not agree on any specific question,this is referred to the general committee for final decision.

Foremen and bosses are given to understand that they are not relieved of responsibility for the safety of their men. The committees are intended to coordinate safety efforts, promote safety interest, and assist the bosses and foremen to make their working conditions safe, but the ultimate responsibility for accidents rests with the boss. Bosses are drawn into discussion of proposed changes to be made in the interest of safety.

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When a committee has decided on a safety measure, it must be put through as quickly as possible, and the order should not be changed or canceled without first consulting the committee. Neither manager, superintendents, nor anyone else may change a ruling of a departmental committee without the approval of the general safety committee or the departmental safety committee concerned.

Rules are enforced or repealed.

Committees see that after safety appliances are provided, the foreman insists on their use.

Each of the underground safety committees takes two days for the inspection. A meeting is held on the second afternoon after the inspection, when both committees' records of the previous month, the accidents for the current month, and the comparison of accidents for the year to date are all read and discussed, after which the meeting is thrown open for the discussion of any new safety suggestions or recommendations that may be brought before the meeting.

While making the inspection, each place is graded and marked in some conspicuous place with chalk as to the conditions found and decided upon by the committee. The following letters are used for grading the working places:

E for places that are in excellent safety condition, and no suggestions are made.

G for places considered good, but one or more minor safety suggestions are made.

M for medium.

P for poor.

This grading has created considerable rivalry among workmen. It is continued with a follow-up letter to each of the shift bosses, commending them for the excellent and good safety conditions found on their runs, and calling their attention to the unsatisfactory conditions. As a rule, the surface inspections are made and completed in half a day.

Following inspections by these committees, meetings are held in which various phases of the inspection are discussed, and letter reports are written by the secretary. Copies of this report are sent to the general manager, mine superintendent, general foreman, bosses, and safety engineer. The reports contain lists of gradings with discussions and reasons, and comparisons with similar gradings in other sections.

Workmen serving on committees wear a safety button during the three months, and a safety watch fob at the conclusion of their term. These buttons and fobs are presented by the company. Men take pride in serving on committees. This system serves as a valuable means of interesting the workmen, and creates large numbers of safety inspectors throughout the plant.

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Each boss holds a meeting once a month underground with all of his men. The time and place is left up to the boss. The length of this meeting is usually about 20 minutes. A chairman and secretary are elected by the men. Discussions are held on various safe methods of mining, with particular emphasis on their own section. The safety engineer attends these meetings when possible, and usually gives a short talk.

In addition to the committee mentioned, there is a grievance committee, the membership of which consists of four men: one from mining department, one from mechanical department, one from concentrating department, and the company claim agent.

All of these men, with the exception of the claim agent, are workmen elected from their respective departments to serve one year. Bosses and salaried men are not eligible to vote or to serve on this committee. Meetings are held once a month and reports are sent to the general manager.

This committee also has charge of a relief fund for needy workmen and their families, into which fund workmen voluntarily pay 25 cents a month, and the company donates an amount equal to the entire workmen's contribution.

Hospital and Doctors

Single men pay $1.35 a month and married men $1.80 a month as hospital fees, for which they receive free medical and surgical treatment on prescription of one of the company's doctors, including drugs, dressings, and hospital for any disease or injury that can be directly attributed to their work. General practitioner services are also rendered free to the families of married men with certain exceptions, and in some cases services are rendered at cost.

Bonuses

The mine supervisory force, including general mine foreman, division foremen, and shift bosses, receive bonuses for safety records as follows:

General foreman ... $55 for clear record each month.
Division foreman .. 50 for clear record each month.
Shift bosses ..... 25 on basis of accidents per 1,000 shifts. Bonus can go over or under this amount.

There is also a sliding scale of bonuses in effect, based on the percentage of time lost to total shifts worked:

Record	Foremen	Shift bosses
Clear	$50	$25
Nor more than 1/2 per cent	40	20
1/2 to 1 per cent	30	15
1 to 1-1/2 per cent	20	10
1-1/2 per cent or more	0	0

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All records start anew each month.

Educational Work

Safety posters obtained from national organizations and also made locally are conspicuously posted on neat bulletin boards at strategic points on the surface.

A course in first aid comprising five lessons of two hours each is given to all new employees by the personnel of the Globe-Miami Mine-Rescue Association. Classes are held at times convenient for the workmen, regardless of the shift on which they might be working, and they are required to complete this course in six weeks or be discharged as a penalty for noncompletion.

At the employment office each man is given a lecture on the rules and policy of the company pertaining to safe work. He is also given a good for which he signs a receipt agreeing to read and abide by the rules contained therein. This book is of a size that is conveniently carried in the pocket and has a substantial binding.

The contents of the book are a forward by the manager, stating the general policy of the company, and a total of 23 rules under the following headings in order:

1. Safety buttons and certificates.
2. General hospital rules.
3. General rules.
4. Goggles.
5. First-aid boxes and tool kits.
6. Shafts and cages.
7. Timbering.
8. Explosives.
9. Electric equipment and haulage.
10. Materials and tools.
11. Holes and openings.
12. Loading from chutes and tramming.
13. Drilling and shoveling.
14. Lights and lamps.
15. General rules to be observed for mine fires.
16. General rules for surface departments.
17. Boiler and engine room.
18. Wood working and all shops.
19. Saws.
20. Jointer.
21. Boring machine.
22. Railroad.
23. Miscellaneous.

In addition to these rules there is a list of special rules for bosses which is included in the appendix.

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Penalties. The penalty imposed for violation of any of the rules contained in the book is left entirely to the boss, and in some instances to the safety committee. There are no set penalties for the violation of any rule.

Safety Buttons and Certificates

1. When an employee of the Old Dominion Co. has completed six months service without a time-lost accident he will be entitled to a safety button. At the end of two years without a time-lost accident a different button will be awarded, and at the end of 5 years without a time-lost accident, a gold and enameled button will be awardod. With the button a certificate will be issued showing the length of time the employee has worked without a time-lost accident. Any man leaving the employ of the company will also be entitled to a certificate showing the length of time he has worked without a time-lost accident; to obtain this certificate he should make application for it to the employment foreman.

2. A time-lost accident is defined as one which causes loss of time after the day in which the accident occurs; 150 days worked will be considered as 6 months, 300 days as 1 year, 600 days as 2 years, and 1500 days as 5 years. Time off will not be counted.

3. An employee who causes an accident to a fellow employee which results in lost time beyond the day on which the accident occurred will be considered as having had a time-lost accident, even if he himself was not injured.

Physical and Mental Qualifications

Some types of work in the mine require certain physical and mental qualifications in order that safe and efficient performance of the same may be assured, such as grizzly work, blasting, etc. With this idea in view, new men are placed on types of work most suitable to their qualifications, as far as possible.

Equipment

The day before starting work, all new men must provide themselves with the following accessories, which are compulsory: hard hat, goggles, carbide lamp, carbide can, matches in moisture-proof container, and safety shoes.

The company charges for the lamp and the hard hat at cost. Credit for these may be obtained and is deducted from the first pay check. Goggles are furnished free.

The wearing of loose or unnecessary clothing is discouraged.

The cager has instructions to prevent anyone from entering the mine unless he is provided with the compulsory equipment; these instructions are carried out thoroughly.

Special equipment such as wrenches, tool sacks, powder sacks, fuse sacks, foot protectors, respirators, etc., is furnished if needed, before a man

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goes to work. Every man is provided with a wrench before going to work, and he is charged for it. When he severs his connection with the company he returns this and receives his deposit.

All men performing work likely to produce flying particles are required to wear goggles.

1. Goggles must be used when chipping with either hand or pneumatic tool. This applies to cleaning as well as cutting metal.

2. Goggles must be used on all grinding with emery wheels, except in the case of grinding plungers and rods with the regular lathe equipment.

3. Goggles must be used when "flogging" tools are held in such a position that a chip or flake might fly upward.

4. Goggles must be used when handling or pouring hot babbitt or lead.

5. Goggles must be used on lathe work when the material being cut is hard or brittle and the cuttings have a tendency to fly.

6. Goggles must be used when there is danger that sawdust and other flying particles may get in the eyes.

7. Goggles must be worn when breaking rock or concrete, unloading lime or while doing any work which endangers the eyes.

8. Goggles must be worn while breaking bowlders, starting holes, picking or moiling hard ground, barring down ground, blowing out holes, barring down chutes from manways, and in all other work where there is danger from flying objects or dust.

Standardization of Work

Because of the several methods of stoping, standardization of all work has been difficult, but certain classes of work such as timbering in development, blasting, haulage, and development have been standardized throughout the mine so that if a man is transferred he will have identical working conditions as far as possible.

Following is an example of equipment furnished and instructions given to men working on grizzlies:

8-pound hammer with one end drawn to a pick point.
Safety belt with rope attached.
Pick and shovel.
Draw hook to turn rock over without using hands.
2 pointed bars, one 4 feet and one 6 feet long, with a loop handle to prevent smashing the hand.

New men are acquainted by the shift boss with the following instructions:

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1. To use goggles when sledging.

2. Not to work one draw raise when the opposite one is hung up.

3. To use standard equipment properly.

4. Not to work without safety belt and rope attached.

5. How to make a primer.

6. How to prepare a "bomb" to place on a stick for blasting hung-up chutes.

7. How to operate blasting signals to notify workmen on haulage level below.

8. How to blast.

SAFETY DEVICES IN THE MINE

Drawings in connection with new work for the entire plant are examined and approved for safety and efficiency by the superintendent and head of the department.

Many safety devices have been standardized in the Old Dominion mine, most of which are foreign to other properties. The most outstanding of these are listed below:

Blasting. - Both the explosive and detonator magazines are of the dugout type, naturally barricaded, and at least 1,000 feet from any building. Electric lights are installed in gasproof containers, and the switches are so arranged that when the door is shut the power is off. An attendant spends his entire time at these two magazines.

One day's supply of explosives is transported underground daily at 9:00 a.m. in the original boxes and hand-trammed from the shaft to the underground explosive magazines, from which it is issued in canvas sacks to the miners.

Underground magazines do not contain more than one day's supply of explosive. They are electrically lighted with globes in gasproof containers. Detonator and explosive magazines are separated by at least 50 feet of solid ground.

About 90 per cent of the blasting is done electrically. Delay detonators ranging from 0 to 15 and of 8X strength are used. Power is 250 volts direct current and is taken from the trolley line. Fuse blasting is employed only in some of the square-set stopes.

Each working place has its individual blasting switch and line. Two wires are run to the working face. The permanent line is kept far enough from the scene of blasting to prevent damage to it. In the stopes all blasting switches are at the entrance. These switches are not locked, but

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have a sign hung on the handle signifying their use. Gaps or interrupters are always in the blasting line between the switch and the face.

After the holes have been loaded, the detonator wires are connected in parallel, and to a temporary blasting line. This line is unrolled and supported, as the miners retreat from the face, and is attached to the permanent blasting line at a safe distance from the scene of blasting. The interrupters are then connected and blasting is done from the blasting switch.

The blasting switch is of the square, D type, encased in a steel waterproof box painted red, the lid of which has a baffle plate so arranged that the switch can not be closed unless the box is open. Coil springs attached to the switch keep it open unless it is held closed.

All men are instructed in the blasting procedure by the bosses.

Explosives have red wrappers and tamping has white wrappers.

Safety Belts.- Safety belts with ropes attached are used in all stopes, at grizzlies, and around shafts and pockets. The ropes are short enough to prevent a man from falling through the grizzly.

Grizzly Covering.- All grizzlies in the stopes are kept covered, when not in use, by two 2 by 12 inch by 6-foot sound planks laid side by side.

Drilling.- All drilling in the mine is done wet. Stoper handles have steel guards so attached that they will protect the hand from falling rocks.

Track Switches.- Track switches leading off the main-line haulage are equipped with air whistles and a red light so arranged that when the switch is thrown against the main line the whistle blows constantly and the red light remains on (see fig. 1).

Ladders.- Ladders are installed in raises, shafts, and other places, with lattice doors at every 20 feet. Lattice doors made from short lengths of ladder are used so that ventilation will be obstructed as little as possible.

A light, rigid steel extension ladder is used to repair chutes and raises. The extensions are 5½ feet long. This ladder has many advantages over the chain or rope ladder--for instance, it has a better hand and foot hold (fig. 2).

When repairing chutes, a clevis is used for lowering or raising timbers. A hole is bored through the timber and the clevis attached by means of a bolt (fig. 3).

Trolley-Wire Guards.- Trolley wires are installed 7 feet above the rail, and box guards are used in front of chutes or where men work near them or pass under them constantly. This guard completely covers the wire. It has a tapered slot at each end. The trolley pole spreads this guard when passing, and the guard closes automatically by its own weight after the trolley has passed (fig. 4).

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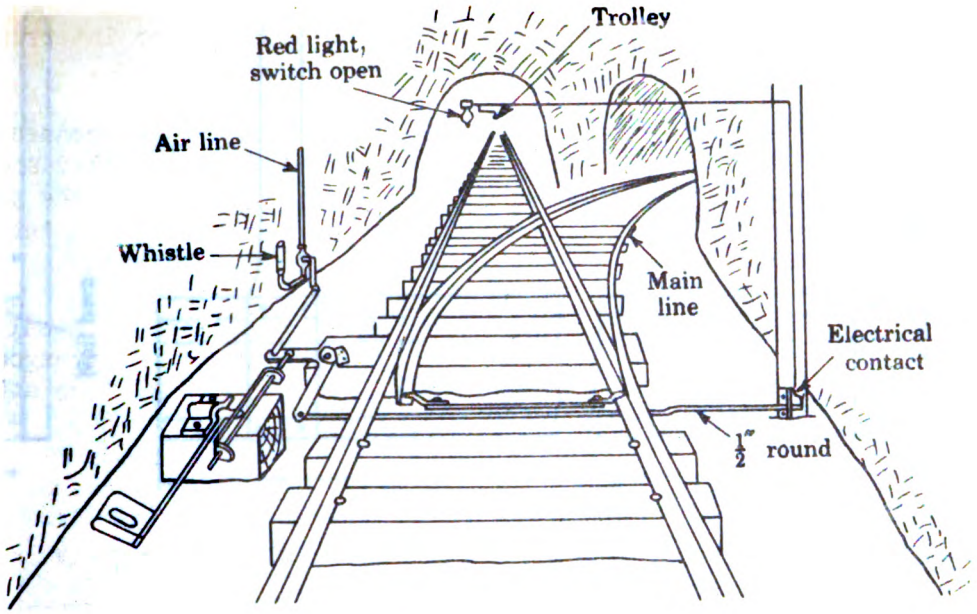

Figure 1.- Whistle and signal-light system

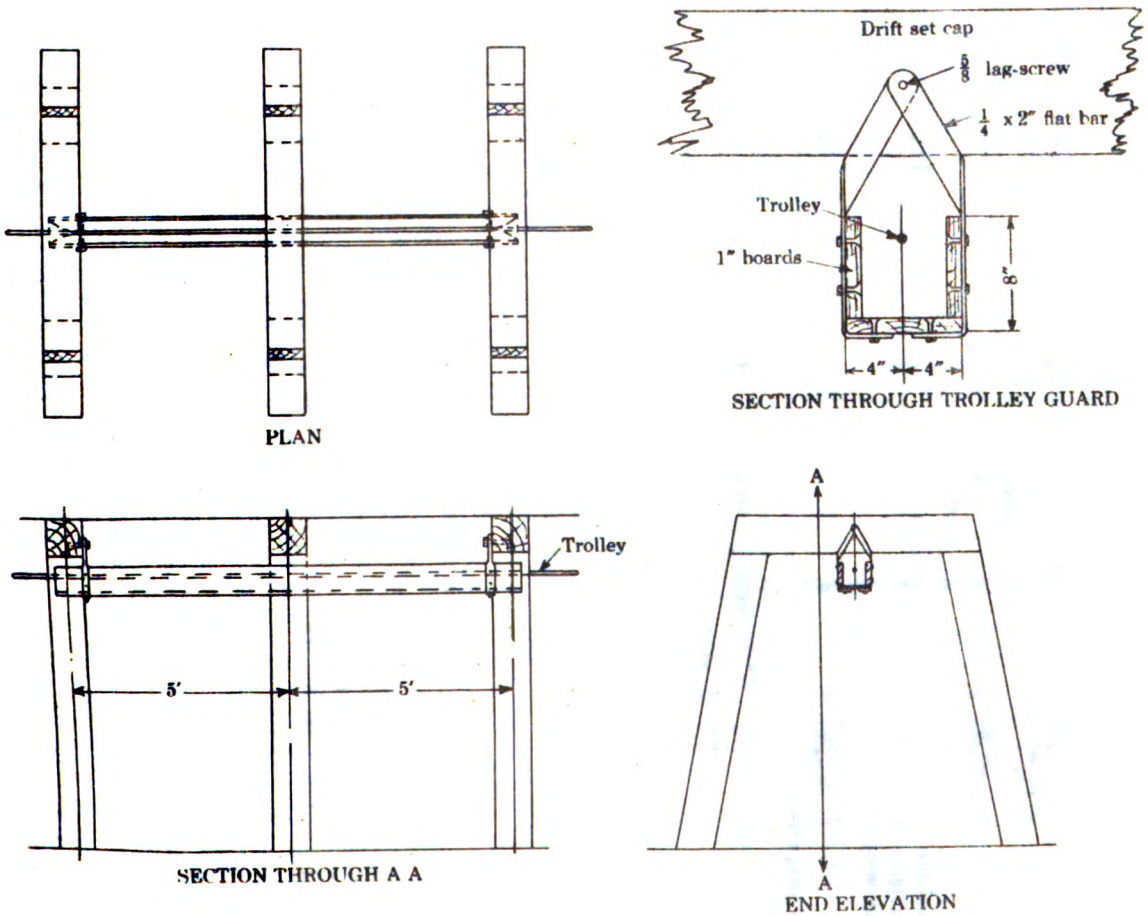

Figure 4.- Trolley guard

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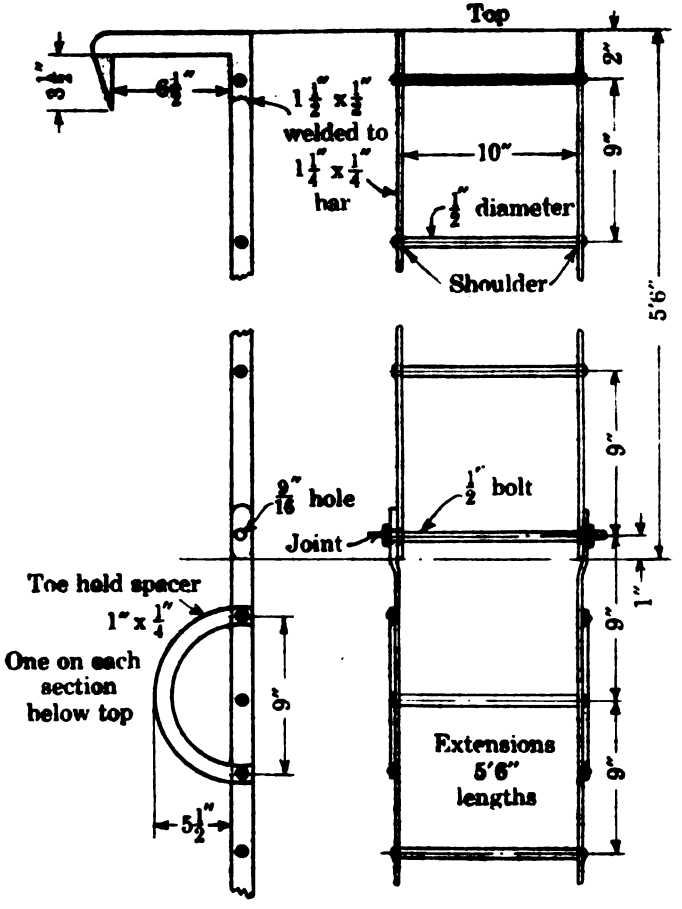


Figure 2.- Steel extension ladder for repairing chutes and raises

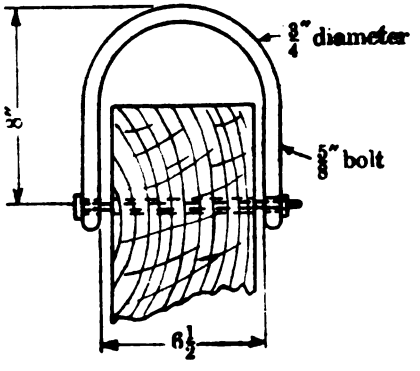
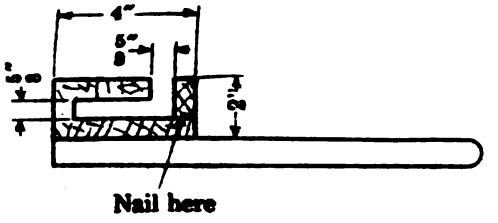


Figure 3.- Six-inch clevis used in repairing chutes



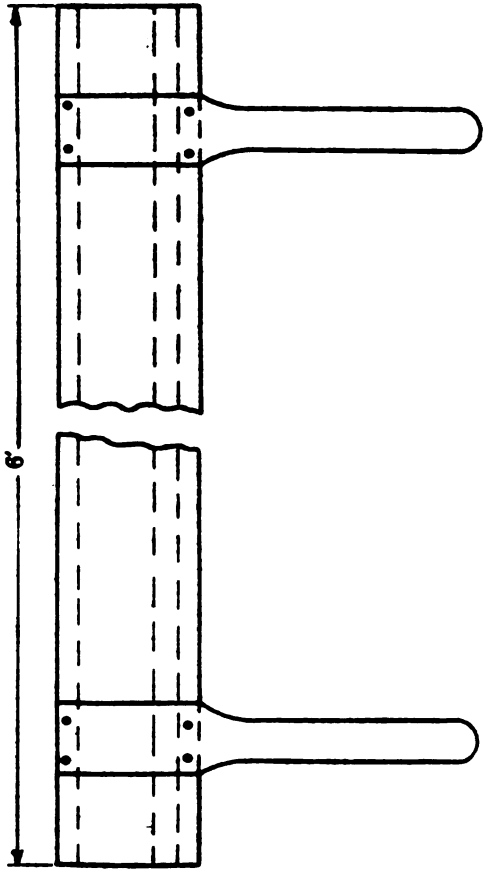


Figure 5.- Portable wooden trolley guard used by repairmen

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Small portable wooden guards are hung on the trolley wire by men performing temporary work. These guards have to be removed before the trolley can pass over the wire (fig. 5).

First-Aid Material.- All employees carry adhesive mercurochrome compresses and ammonia inhalants. Large first-aid cabinets are kept at strategic points underground and contain the following materials:

1 bottle of picric acid.
Splints for leg and arm.
1 pound of cotton padding.
18 triangular bandages.
12 1-inch roller bandages.
12 2-inch roller bandages.
24 1 to 4-inch sterile compresses.

Long leg splints are used in place of the regular broken-back splint.

Trash Disposal.- One man spends his entire time cleaning up around the shaft stations and other places where trash accumulates.

Fire Prevention.- All workings are equipped with water lines for fire fighting, and enough hose connections are made for regular air hoses, since there is always a supply of these on hand, and miners are familiar with their use. The air line is also so arranged that water can be turned into it in the event of an emergency. In addition to this, fifty-fix 2½-gallon capacity soda-acid fire extinguishers are stored at strategic places underground. Pyrene extinguishers are used on the surface.

Miners can be warned by means of a stench system attached to the air line and also by signals on the light line.

Regular fire drills are held on the surface.

Emergency boxes containing the following equipment are kept on all levels, several being on the larger levels:

1 4-pound hammer.
1 18-inch stilson wrench.
1 24-inch stilson wrench.
1 handsaw, 5 teeth to the inch.
1 claw bar.
6 double connections for air hose.
12 rubber gaskets.
1 wood chisel.
1 cold chisel.
6 ladder hooks.
24 pipe staples.
4 pounds assorted nails.
1 light axe.
Bell reducers ½ to ¾ inch, ¾ to 1 inch, 1 to 1½ inches
1½ to 2 inches.

All fire equipment is regularly inspected.

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REPORTS OF ACCIDENTS

All injuries, whether they are serious or not, are reported by the bosses on regular forms.

If the accident is serious enough to require medical attention, the boss issues a blue card to the injured workman which he presents at the hospital. This card is returned to the general foreman by the doctor, and is later given to the shift boss when the man returns to work.

If the workman fails to report to his boss and goes to the hospital for treatment, a red card from the hospital is sent to his boss when he returns to work.

A man reporting to the hospital must be formally released before returning to work. Reproductions of the cards follow (fig. 6).

FIRST-AID AND MINE-RESCUE FACILITIES

The company is a member of the Globe-Miami Mine-Rescue and First-Aid Association which maintains a station 1 mile from the mine. At this station first-aid and mine-rescue apparatus is kept in readiness at all times for emergency use. Trucks are kept equipped with this apparatus so that there is a minimum of delay in getting to the scene of a disaster.

The personnel of the station consists of a director and three assistants, one of whom is on duty at all times. First-aid and mine-rescue training is given to employees of the Old Dominion Co. by the station personnel.

In 1930, all employees of this company were trained in first aid by a representative of the United States Bureau of Mines, and since then all new men have been trained in first aid by the personnel of the Globe-Miami Mine-Rescue and First-Aid Association.

A crew of 15 men has been trained in mine-rescue and recovery operations and receives additional training every month. There are also crews available on short notice from other mining companies in the district. These men receive a bonus of 30 cents a day.

A copy of the examination given these men is included in the appendix.

Tables 1, 2, and 3 give the accident statistics for the Old Dominion Co. and the Phelps Dodge Corporation, and Figure 7 shows the lost-time accidents over a 7-year period.

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ACCIDENT ON DUTY

ACCIDENT CERTIFICATE FOR MEDICAL ATTENTION
OLD DOMINION COMPANY

Date.....Hour.....

Old Dominion Dispensary (or Hospital).
Globe, Arizona.

The bearer,.....No.....
is entitled to receive medical attention on account of an alleged injury received

While working for the Company on the.....day of.....193.....

at.....P. M. or (A. M.)

.....
Time keeper, Foreman or Shift Boss.

This card must be presented at the Dispensary or Hospital before the expiration of 24 hours from the time of accident and returned to the General Office.

Received at O. D. Dispensary (or Hospital), Date.....Hour.....

By.....

Blue card issued by boss to injured workman

ACCIDENT ON DUTY

ACCIDENT CERTIFICATE OF MEDICAL ATTENTION
OLD DOMINION COMPANY

Date.....Hour.....

Old Dominion Company
Globe, Arizona

..... Shift Boss

The bearer.....No.....

has received medical attention on account of an alleged injury while working

for the Company on the.....day of.....19..... at .....M.

Probable loss of time.....

By..... M. D.

Red card issued by hospital to injured workman

Figure 6.- Medical attention certificates

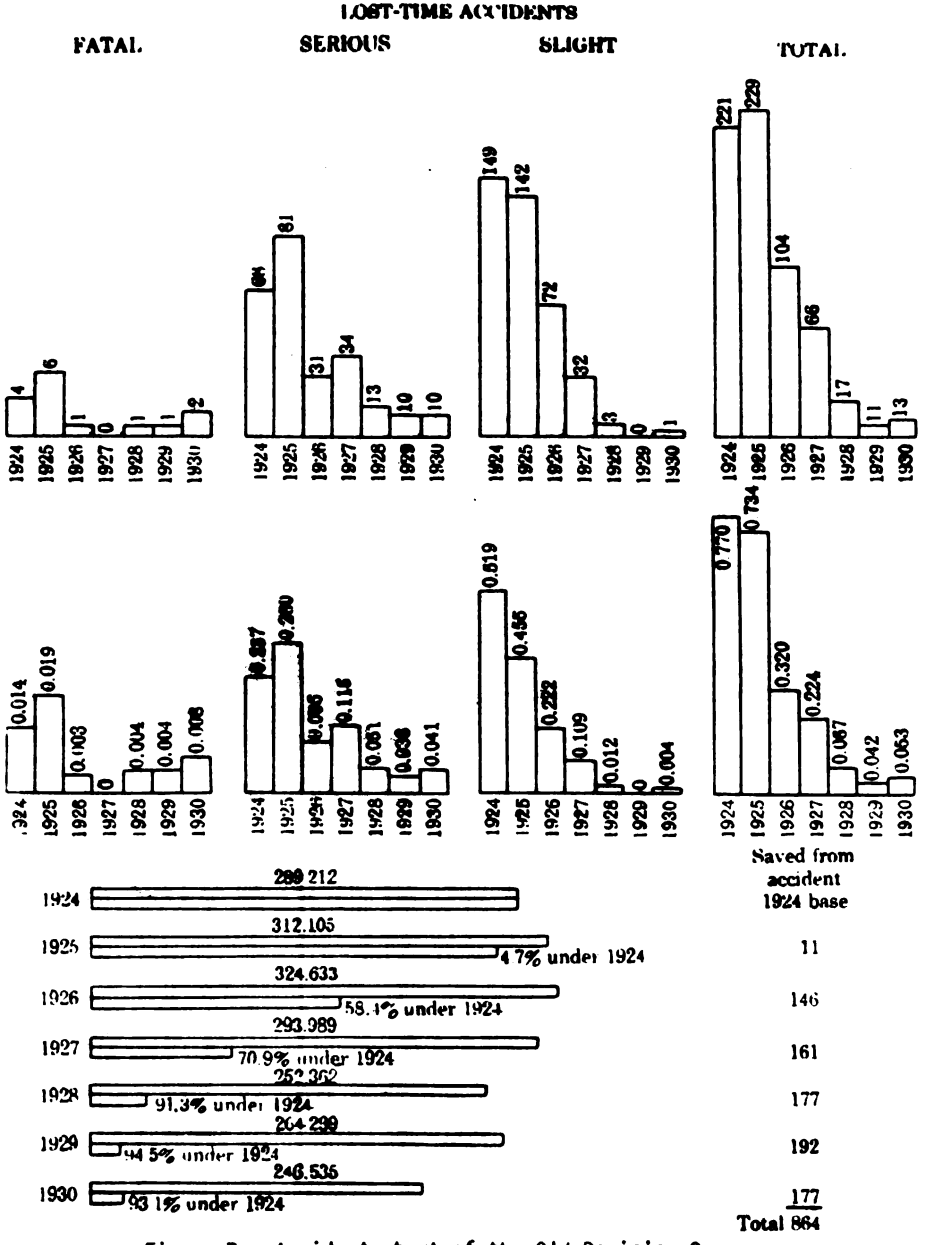

Figure 7.- Accident chart of the Old Dominion Co.

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Table 1. - Lost-Time accident record of the Old Dominion Co.

Department	1930			1929			1928		
	Number	Total shifts	Per 1000 shifts	Number	Total shifts	Per 1000 shifts	Number	Total shifts	Per 1000 shifts
Underground mining	10	144,158	0.069	10	163,182	0.061	15	153,006	0.098
Crushing and concentrating	0	21,186	.000	1	20,500	.049	0	20,303	.000
Mechanical and shops	2	54,810	.036	0	52,813	.000	2	51,269	.039
Miscellaneous surface	1	13,538	.074	0	14,291	.000	0	13,179	.000
All other	0	12,843	.000	0	13,513	.000	0	14,605	.000
Total	13	246,535	0.053	11	264,299	0.042	17	252,362	0.067

Department	1927			1926			1925		
	Number	Total shifts	Per 1000 shifts	Number	Total shifts	Per 1000 shifts	Number	Total shifts	Per 1000 shifts
Underground mining	58	186,307	0.311	86	209,222	0.411	204	198,231	1.029
Crushing and concentrating	6	21,620	.277	2	22,273	.090	2	22,452	.089
Mechanical and shops	1	55,836	.018	14	58,502	.239	18	55,376	.325
Miscellaneous surface	1	13,819	.072	2	16,498	.122	5	18,146	.276
All other	0	16,407	.000	0	18,138	.000	0	19,900	.000
Total	66	293,989	0.224	104	324,633	0.320	229	312,105	0.734

Table 2. - Departmental Lost-time accident records of the Old Dominion Co.

Department	Present record			Best record		
	Date last accident	Days clear	Shifts worked	Successive days clear	Shifts worked	Dates
Underground mining	12/9/30	22	9,000	237	101,300	10/25/29 to 6/20/30
Crushing and concentrating	12/3/29	393	22,777	745	41,700	11/27/27 to 12/3/29
Mechanical and shops	8/15/30	138	18,574	713	103,300	1/21/28 to 1/5/30
Miscellaneous surface	9/17/30	105	3,159	1,229	50,500	5/5/27 to 9/17/30
All other departments	None since 1924	2190	103,065	2,190	103,065	12/31/24 to 1/1/31
Total	12/9/30	22	15,000	165	120,700	1/5/30 to 6/20/30

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Table 3. - Lost-time accidents of the Old Dominion Co. and the Phelps Dodge Corporation.

Properties	Fatal		Serious		Slight		Total	
	Number	Per 1000 shifts	Number	Per 1000 shifts	Number	Per 1000 shifts	Number	Per 1000 shifts
1924								
Copper Queen Branch	6	0.008	219	0.247	615	0.695	840	0.950
Moctezuma Copper Co.	9	.018	112	.224	738	1.478	859	1.720
Morenci Branch	1	.002	198	.450	267	.607	466	1.053
Old Dominion Co.	4	.014	68	.237	149	.519	221	.770
Four metal branches	20	0.009	597	0.283	1769	0.838	2386	1.130
1925								
Copper Queen Branch	2	0.002	166	0.184	315	0.349	483	0.535
Moctezuma Copper Co.	3	.005	51	.093	229	.418	283	.516
Morenci Branch	3	.007	133	.293	263	.578	399	.878
Old Dominion Co.	6	.019	81	.260	142	.455	229	.734
Four metal branches	14	0.006	431	0.195	949	0.428	1394	0.629
1926								
Copper Queen Branch	2	0.002	82	0.094	111	0.128	195	0.224
Moctezume Copper Co.	4	.007	26	.046	56	.100	86	.153
Morenci Branch	0	.000	49	.113	65	.151	114	.264
Old Dominion Co.	1	.003	31	.095	72	.222	104	.320
Four metal branches	7	0.003	188	0.086	304	0.139	499	0.228
1927								
Copper Queen Branch	6	0.007	81	0.093	45	0.052	132	0.152
Moctezuma Copper Co.	3	.005	16	.027	18	.030	37	.062
Morenci Branch	2	.005	18	.046	8	.020	28	.071
Old Dominion Co.	0	.000	34	.115	32	.109	66	.224
Total metal branches	11	0.005	149	0.069	103	0.048	263	0.122
Stag Canon Branch (coal)	5	.016	53	.175	109	.359	167	.550
Total all branches	16	0.007	202	0.082	212	0.086	430	0.175

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Table 3. - Lost-time accidents of the Old Dominion Co. and the Phelps Dodge Corporation--Continued

1928

Properties	Fatal		Serious		Slight		Total	
	Number	Per 1000 shifts	Number	Per 1000 shifts	Number	Per 1000 shifts	Number	Per 1000 shifts
Copper Queen Branch	2	0.002	49	0.060	22	0.027	73	0.089
Moctezuma Copper Co.	6	.010	13	.021	8	.013	27	.044
Morenci Branch	5	.013	9	.024	2	.005	16	.042
Old Dominion Co.	1	.004	13	.051	3	.012	17	.067
Total metal branches	14	0.007	84	0.040	35	0.017	133	0.064
Stag Canon Branch(coal)	5	.020	44	.176	29	.117	78	.316
Total all branches	19	0.008	128	0.055	64	0.028	211	0.091

1929

Copper Queen Branch	3	0.003	41	0.040	5	0.005	49	0.048
Moctezuma Copper Co.	4	.006	16	.025	4	.007	24	.038
Morenci Branch	-	---	6	.013	-	---	6	.013
Old Dominion Co.	1	.004	10	.038	-	---	11	.042
Total metal branches	8	0.003	73	0.031	9	0.004	90	0.038
Stag Canon Branch(coal)	1	.005	22	.113	3	.015	26	.133
Total all branches	9	0.003	95	0.037	12	0.005	116	0.045

Four metal branches, per cent decrease in 1929 accident rate compared with year

1928	57.2	22.2	76.5	40.6
1927	40.0	55.1	91.7	68.9
1926	-	64.0	97.1	83.3
1925	50.0	84.1	99.1	94.0
1924	66.6	88.2	99.5	96.3
1923	76.9	87.7	99.5	96.1

1930

Copper Queen Branch	2	0.003	24	0.036	3	0.004	29	0.043
Moctezuma Copper Co.	3	.006	14	.030	2	.004	19	.040
Morenci Branch	2	.005	6	.015	2	.005	10	.025
Old Dominion Co.	2	.008	10	.041	1	.004	13	.053
Total metal branches	9	0.005	54	0.030	8	0.005	71	0.040
Stag Canon Branch(coal)	1	.009	15	.140	2	.019	18	.168
Total all branches	10	0.005	69	0.037	10	0.005	89	0.047

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CONCLUSION

The Old Dominion Co. has been able to create and maintain in the last few years an enviable safety record. This is all the more apparent when adverse working conditions are taken into consideration. Such an accomplishment has been made possible by the enthusiastic support given the safety department by every man from the manager down, the realization that safety starts at the top and must be treated as a major operating problem, an intelligent study of working conditions, and the adaptation of the principles of safety to those conditions.

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APPENDIX

UNDERGROUND

Foremen and Bosses Safety Rules

The following instructions are issued to foremen and bosses of the Old Dominion Co.:

In case of a serious injury some one must be sent with the injured man to see that he has proper care until arrival at the hospital.

Blue cards are provided which must be filled out by the boss and issued to all injured men to take to the doctor for treatment.

All new men must be taken to the call-bell on the station of the level on which they are working and given full instruction in the use of the same for calling the cage, for the purpose of eliminating all chances of having any person ring the wrong bell.

Any boss who sees a man working under conditions which he considers dangerous, although he is working for another boss, must stop him immediately and have the other boss notified as quickly as possible.

Bosses who have untimbered drifts which they consider too dangerous to work without timbering, must take immediate action to secure the same, or place men elsewhere and notify their foreman.

Rigid inspection of drifts in the raw must be made to secure solid back and sides.

Timbered Drifts. All timbered drifts, either in ore or waste, which can be picked must be equipped with a top bridge high enough to take 4-inch spiling if necessary, and either plank or spiling must be put in as the shifter decides is necessary.

Timber in the level above working raises must be caught up before the raise is broken through. If the raise is coming through on the run of another foreman, the foreman in charge of the raise must notify him of the same and see to it himself that the work is done before breaking through.

Bosses must not allow one man to work alone in dangerous places.

Smoking shall be strictly prohibited on cages, moving man-trucks, timber stations, powder magazines, or while carrying or handling explosives.

See that men who are to be hoisted, line up back of turnsheet and take their regular turn without crowding. Bosses are instructed to discharge all violators.

Bosses must call to the attention of men fooling on the job with others, especially while riding on cages, the regulation prohibiting this practice, and see that it is strictly enforced.

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The doorways on the skip compartments on stations where men get off and on must be kept clean.

At the time brass checks are given to new men going underground, the time clerk shall also issue to each man a pair of goggles with the printed instructions for wearing them.

It must be seen to that all men are provided with goggles and that they are being worn by them while engaged in breaking bowlders, starting holes, picking hard ground or moiling, barring down ground, blowing out holes, barring down chutes from manways, and all other work where there is danger of flying objects or dust.

Where men are not provided with goggles for use in their work, all eye injuries that might have been prevented by the wearing of goggles shall be classed against supervision, except in cases where inability to secure goggles has been previously reported.

Men working in drifts must use the light signals provided for that purpose to prevent being run into by motor trains; and before leaving, the signals must be removed.

Trolley-line boxes must be provided for men working around trolley lines, and bosses must insist on their use.

Motormen must leave the reverse lever on their motor in neutral, and remove trolley pole from wire whenever necessary for them to leave their motor.

Instruct motormen to slow down their trains when meeting men in drifts.

Discipline must be used with men caught coupling cars while the train is in motion, by giving them a short lay-off for the first offense, and discharging them for the second offense.

No person, including motorman and brakeman, shall get off or on motors, man-trucks or mine cars, while in motion.

Motormen either pulling or pushing trucks loaded with timbers must have a mine-car between the motor and timber truck to protect himself and helper against being caught with the timber.

All switches in main haulage drifts must be equipped with red lights and whistles, and the switch points must be left turned for the main haulage drifts at all times.

As soon as a missed hole is detected in a working place, all work must be stopped until the missed holes are blasted.

Men are strictly forbidden to enter any place after blasting in case of misfire, or for a period of 30 minutes from the time the fuse was lighted.

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Hardwood skewers must be provided for boring holes in powder to insert caps.

Blasting switch boxes must be marked to correspond with the working place for which the box is used, and must have a tag attached bearing the words DANGER - DO NOT OPEN.

All timber being blasted must be done allowing safe time to return and make an inspection for fire before going off of shift.

Men blasting with electricity must be instructed to touch the ends of the lead wires together before connecting them to the wires from the holes. In case they get a spark when touching the wires they are to make a thorough inspection for the trouble and have it fixed before connecting the wires.

Drifts. All level development must be blasted with electricity from the start.

Raises. All level raises must be blasted with electricity from the butt caps. No deviation from this rule will be permitted except by first securing permission from the foreman.

Failure to secure blasting equipment will not make the use of fuse permissible, but must be reported to the foreman at once.

Before climbing up a working raise the air must be turned off, then turned on, and then turned off again with a short pause between each operation. Then get in communication with the men in the raise and if it is all right to climb up, turn the air on and go up. When down out of the raise and in the clear, signal to the men in the raise by turning the air off and on again.

All raise manways must be properly covered at the top while men are climbing up or down.

For hoisting and lowering timbers a chain must be attached to the rope and two hitches made around the timber.

The promiscuous dumping of carbide from lamps where the dust and fumes are offensive to other men in strictly forbidden. Bosses are requested to see that this rule is not being violated.

For erecting stages underground, the plank being used to nail against the posts must have two (2) nails at each end.

All manways not in good condition to travel through, also those that are in good condition but temporarily blocked by obstructions so that a person can not pass through, must be marked with a sign, CLOSED.

Temporary universal danger notices only, must be used as temporary danget signs for protecting men working in chutes, manways, etc. These notices must be properly filled in and dated, and removed immediately when no longer needed.

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A brace, bit, and clevis must be supplied to the men, with instructions to use them wherever it is necessary to work under timber being hoisted or lowered.

Dust must be dampened wherever possible, on machines and other places.

All intakes and the exposed working parts on the fan blowers must be kept guarded.

All loading places at chutes where men have to stand and load cars must be extended back so as to be not less than three (3) feet from the side of the cars.

See that care is exercised in piling timbers in main drifts and crosscuts, and have the timber kept in the timber stations wherever possible.

See that pipes in manways are put in so as not to interfere with men climbing on the ladders.

When putting in air or water lines, staples must be used for the small pipes, and hooks for the large pipes, to hold them in place.

Enough trolley-line boxes must be used to extend several feet each way from where repairmen are working.

The wearing of fuse for belts is strictly forbidden.

Fire Prevention and Protection. All abandoned workings, not needed for the operation of the mine, and in which there is a fire hazard, should be sealed with gunite stoppings.

All stations, rooms, and recesses constructed of wood, or other inflammable material for the installation of electrical equipment, must be thoroughly fireproofed.

Trolley wires must not touch caps of drift sets or projecting timbers.

All lamp sockets and fuse boxes must not be less than six inches from timbers.

Levels extending long distances from mine openings must be provided with permanent fire doors at intervals not exceeding 1000 feet.

The use of carbide lamps with swivel hooks is prohibted.

Careless men, especially those who have been previously warned, must be disciplined by a short lay-off for the first offense and discharge for the second offense.

Bosses on duty when mine is not working are in full charge and are responsible for existing conditions, and in case of emergencies, must take immediate action.

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General Rules to be Observed for Mine Fires

(Amended March 15, 1927)

1. The first consideration must be the safety of all the men.

2. All air currents are to be maintained as nearly normal as possible until men are out of mine. Fans should not be reversed or stopped except on order from general mine foreman, superintendent, or manager.

3. All engineers must be thoroughly familiar with giving the fire signal.

4. Each shift boss must have a sufficient number of men chosen, instructed regarding the available exits and assigned to certain portions of his run, to enable him to get the men assembled as quickly as possible.

5. Powdermen and carmen must be thoroughly instructed regarding fire signals and should be kept informed at all times as to what men are chosen to make the assemblage and where they are working. Dated lists should be kept at the powder houses and revised at least once each month.

6. Any one discovering fire or dense smoke which can not be put out at once must immediately notify shift boss in charge of run, or if unable to locate him at once, then the powderman or assembly men must be notified, who will appoint some one to go to A shaft and ring the accident call, 7 BELLS, on the call bell, followed by level signal, for cage. When the cage arrives, he, himself, must go on top to the engine room and notify the engineer to give the fire signal, 3 - 3 - 3, on electric-light lines. He must then go to the time office and notify the clerks to call the mine-rescue station and mine officials.

7. The mine master mechanic, chief electrician and general mine foreman shall be notified immediately to send to all hoisting shafts a hoisting engineer and cage tender to get the men out of the mine, and an electrician to maintain the working of all the electrical equipment. All men assigned to these duties must remain there until further orders.

8. Shifters being notified of fire must have his powderman and assembly men notify all men to gather while he, himself, determines how to put out or control the fire. If there is any doubt as to the safety of the men he must proceed to get the men out at once.

9. When all the men are assembled they will proceed to the A shaft if possible, or if it is not possible to reach the A shaft without danger, they will take the best available exit.

10. The exit signs along drifts indicate way on all levels from A shaft to emergency exits.

11. All abandoned drifts must be marked by crossed lagging with a CLOSED sign.

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12. Regardless of the exit used, each employee must call for his check at the time office at A shaft so that all men can be checked out.

13. It shall be the duty of all shift bosses to see that these rules are compiled with at all times.

A copy of the examination given crews trained in mine-rescue work follows:

QUESTIONNAIRE FOR DISTRICT BONUS MINE-RESCUE CREW,
GLOBE-MIAMI DISTRICT MINE-RESCUE AND FIRST-AID ASSOCIATION

Assembly of Apparatus

Have crew member who has tested his apparatus previously, throw apparatus on his back, couple it up and wear under oxygen in your presence for 5 minutes

The order for putting apparatus in operation is

(1) Throw apparatus on back (after goggles are on) - - - _____

(2) Put mouthpiece in mouth - - - - - - - - - - - - - - _____

(3) Turn on "regular" valve - - - - - - - - - - - - - - _____

(4) Put on nose clip - - - - - - - - - - - - - - - - - - _____

(5) Fill breathing bag 2/3rds full using by-pass valve _____

(6) Tighten side straps - - - - - - - - - - - - - - - - _____

(7) Read gauge - _____

Was this order observed? - - - - - - - - - - - - _____

Examiner will please note

(8) Are goggles right side up and is elastic tight enough? - _____

(9) Is harness properly arranged? - - - - - - - - - - - _____

(10) Are all harness straps and buckles as they should be? _____

Which ones wrong? _____

_____

_____

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(11) Is mouthpiece "aimed properly"? - - - - - - - - - - - - - - - _____

(12) Is apparatus fully and properly equipped? - - - - - - - - - _____

(13) Nose clip? - _____

(14) Mouth piece plug? - _____

(15) Self Rescuer? - _____

(16) If there are apparent leaks are they due to:

(17) Loose connections? - _____

(18) Lack of gaskets? - _____

(19) Through nose? - _____

Apparatus

(20) Make? - Draeger - _____

(21) Kind? - 2 hour - _____

(22) Type? - Positive-pressure by-pass, fixed feed - - - - - - - _____

(23) Weight? - 43 lbs. - _____

(24) Weight of oxygen cylinder? - 11 lbs. - - - - - - - - - - - _____

(25) Size of oxygen cylinder? - 2 liters - - - - - - - - - - - - _____

(26) How much oxygen is in 2-hour cylinder when filled to 150 atmospheres pressure? - 300 liters - - - - - - _____

(27) How test for leaks? - (In water) capped and not capped (valve on and off) - - - - - - - - - - - - - - - - _____

(28) How test for valve tightness? - Capped with valve open and valve closed - - - - - - - - - - - - - - - - - - _____

(29) Explain "blow off" on oxygen cylinder. - Located on valve head and should blow off at 3,000 lbs. pressure per sq. in. - _____

(30) What is an atmosphere in pressure per sq. in.? 14.7 lbs. at sea level (about 13 lbs. here) - - - - - - - - - _____

(31) How much in volume is a liter? - 1 1/8 quarts (approx) _____

(32) What is the pressure in pounds per sq. inch in full oxygen cylinder? - Approximately 1,950 lbs. - - - - - _____

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(33) What part of apparatus is used to regulate the pressure while in operation? - Reducing valve - - - - - - - - _____

(34) To what pressure is the bottle pressure reduced for operation & wearing? - 2.3 oz. per sq. in. - - - - - _____

(35) How much water gauge? - 10 centimeters or 4 inches - _____

(36) What part of apparatus regulates the flow of oxygen? - Reducing valve - _____

(37) How much oxygen should be admitted through the reducing valve to the breathing mixture each minute? - 2½ liters _____

(38) What part of the apparatus produces the circulation? Injector - _____

(39) Where located? - In mixing chamber of reducing valve _____

(40) What rate of flow is provided per minute by this part? About 60 liters per minute - - - - - - - - - - - - - - - _____

(41) How measured? - By liter bag - - - - - - - - - - - - _____

(42) What two kinds of regenerators are used? Cardoxide and Potash - - - - - - - - - - - - - - - - - - - _____

(43) Describe the cardoxide canister? - Copper refillable - _____

(44) Weight? - 5½ lbs. - - - - - - - - - - - - - - - - - - _____

(45) How much cardoxide required to fill? - 4 lbs. - - - _____

(46) How long will charge serve? - 3 hours - - - - - - - - _____

(47) Intermittent or continuous? - Both - - - - - - - - - _____

(48) Temperature? - Cool - - - - - - - - - - - - - - - - - _____

(49) Describe potash regenerator? - Not refillable; is a sealed tin canister - - - - - - - - - - - - - - - - - - _____

(50) Weight? - 4.2 lbs. - - - - - - - - - - - - - - - - - _____

(51) Contents weight? - 2.2 lbs. - - - - - - - - - - - - - _____

(52) Number of screened shelves - 26 - - - - - - - - - - _____

(53) Shelf area? - 9½ sq. feet - - - - - - - - - - - - - _____

(54) How long will fresh canister serve? - 2 hours - - - _____

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(55) Continuous or intermittent? - Continuous only - - - _____

(56) Temperature while using? - Gets hot - - - - - - - - - _____

(57) What provision is made for cooling the air that becomes heated in the regenerator? - Air cooler - - - - - - - _____

Describe the breathing bag

(58) Direction of flow of air in or out of each hole? - - - _____

(a) Fresh air enters lower opening under right side and leaves upper right front - - - - - - - - - - - - - - _____

(b) Exhaled air enters upper front left side and goes out left lower underside - - - - - - - - - - - - - - _____

(59) Is there an opening between the two sides of breathing bag? - Yes - _____

(60) Why? - To furnish air to the wearer when his requirements are in excess of amount available in fresh air side of bag - _____

(61) Is there a release valve? - Yes, but it has been blocked as it releases too easy - - - - - - - - - - - - _____

(62) How do you release when apparatus is too full? Let air out around mouthpiece while squeezing bag - - _____

Describe the by-pass

(63) Location? - Angle valve on oxygen cylinder - - - - - - _____

(64) Action? - Admits oxygen through by-pass tube to mixing chamber - _____

(65) When used? - For filling apparatus to test for leaks _____

(66) For filling apparatus to start wearing - - - - - - - - _____

(67) For filling apparatus after scrubbing apparatus - - - _____

(68) For filling apparatus when temporarily short on air - _____

(69) For filling apparatus to make apparatus usuable when reducing valve has failed or apparatus is rendered out of order while wearing - - - - - - - - - - - - - - _____

(70) Describe scrubbing of apparatus or nitrogen accumulation - _____

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If at the end of one hour the apparatus is full of air, the breathing bag should be squeezed empty and the apparatus refilled by using the by-pass - - - - - - - -

(71) Why is scrubbing necessary? - The oxygen used contains as high as 2% nitrogen. This nitrogen can accumulate until at the end of one hour the mixture of air in apparatus could have an excess of nitrogen, which is occupying space needed for oxygen - - - - - -

(72) Describe the dial readings on pressure gauge? Atmosphere pressure and minutes per hour - - - - - - -

(73) 50 atmospheres is good for how many minutes? - 40 min.

(74) 100 " " " " " " " - 80 "

(75) 150 " " " " " " " -120 "

Describe the mouthpiece

(76) Direction of intake and outgo? - Right to left - - -

(77) Valves are for what purpose? To control the direction - - - - - - - - - - - - - - -

(78) How can one test these valves to determine if flow is in proper direction while wearing? - By collapsing first one respiration tube and then the other - - - -

What is the direction of flow of air in

(79) Right side of breathing bag? - Up - - - - - - - - -

(80) Left side of breathing bag? - Down - - - - - - - - -

(81) Cooler? - Down - - - - - - - - - - - - - - - - - -

(82) Regenerator? - Up - - - - - - - - - - - - - - - - -

(83) In the long stiff circulation tube? - From bottom of cooler to breathing bag - - - - - - - - - - - - - - - -

(84) In short stiff circulation tube? From breathing bag to mixing chamber - - - - - - - - - - - - - - - - - - -

Is the composition of air mixture "good" or "bad" or all oxygen in the

(85) Cooler? - Good (except for cooling) - - - - - - - -

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(86) Mixing chamber? - Good and bad - - - - - - - - - - _____

(87) Right side of breathing bag? - Good - - - - - - - - _____

(88) Left side of breathing bag? - Bad - - - - - - - - - _____

(89) Does "good" and "bad" or just "bad" air enter the regenerator? - Both - - - - - - - - - - - - - - - - - _____

Explain 4 tests for

(90) Cardoxide refillable regenerator? - Freshness of charge which you made yourself or by cotton and adhesive tape already on cartridge opening - - - - - _____

(91) For leaks? - By blowing into it - - - - - - - - - _____

(92) For stoppage? - By blowing through it - - - - - - - _____

(93) For bent or damaged ends? - - - - - - - - - - - - - - _____

Explain 5 tests for

(94) Potash regenerator? - Freshness by seals and shaking to note if contents are granular - - - - - - - - - - _____

(95) For tightness by blowing into - - - - - - - - - - - _____

(96) For stoppage by blowing through - - - - - - - - - - _____

(97) For bent or damaged ends - - - - - - - - - - - - - - _____

(98) Screens too close to ends - - - - - - - - - - - - - _____

(99) How do you test for low pressure leaks in apparatus? Block mouthpiece with one hand and fill apparatus, using by-pass valve. If leaks are present the bag will wilt noticeably in 15 seconds - - - - - - - - - _____

(100) Why should you listen for "hum"? - A "good" hum will denote a proper amount of air and oxygen in circulation - _____

(101) How do you test for high pressure leaks and where? With spark on brass parts only. Around oxygen cylinder valves, wrench connection, around reducing valve union, around to pressure gauge, on reducing valve blow off and around pressure gauge - - - - - - - - - _____

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(102) What are the cleaning and sterilizing requirements of apparatus and for what parts? - Rinse * soap with brush, rinse in fresh water, then in lysol solution, corrosive sublimate solution and then in potassium permanganate solution and hot water, rinse (live steam if available)
Mouthpiece, respiration tubes, breathing bag - - - - _____

(103) While wearing the apparatus, 300 liters of oxygen is added to the contents of the apparatus from the oxygen cylinder during the two hours - - - - - - -
An equal volume is inhaled and exhaled at each breath. What becomes of this extra 300 liters in volume? - The oxygen enters the lungs as such and part is changed into carbon dioxide which is exhaled and absorbed by the contents of the regenerator - - - - - - - - - - - _____

(104) How many men shall compose a crew? - Five - - - - _____

(105) Is it permissible for one man to return to fresh air alone? - No - _____

Demonstrate how to use

(106) Water gauge on apparatus - - - - - - - - - - - - - - - _____

(107) Liter bag on apparatus - - - - - - - - - - - - - - - - _____

(108) How much of the apparatus has a negative pressure while in operation? - From left side of mouth piece through left respiration tube, left side of breathing bag and through short stiff circulation tube to vacuum chamber - _____

Half-hour Apparatus

(109) For what purpose is half-hour apparatus used? For exploration or errand work or to take to men to use who have to be brought through smoke, or is to be worn at time of Mine Fire by those traveling in the mine who might encounter smoke - - - _____

(110) Describe apparatus

(111) Is good for half-hour only - - - - - - - - - - - - - - _____
Is a by-pass type apparatus - - - - - - - - - - - - - - - _____

(112) How worn and used? - Have crew member put it in position to wear and show how to operate and read gauge - _____

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(113) Where are they stored at applicant's plant? - - - - _____

(114) Where are the two on the rescue truck stored?
On right front of top deck - - - - - - - - - - - - _____

(115) How full is the oxygen cylinder filled?
150 atmospheres - - - - - - - - - - - - - - - - - - _____

(116) Describe regenerators? - Cardoxide, Potash - - - - _____

Oxygen Pumps

(117) Are the thread connections a standard or metric thread? - Metric - - - - - - - - - - - - - - - - _____

(118) How can you connect the large oxygen cylinder which has standards threads to the pump, that has only metric threads? - By using an "adaptor" - - - - - _____
(Have crew member pick one out from the articles on desk) - _____

(119) Why use three large cylinders for the pump?
To enable the use of more of the oxygen from each large cylinder, by using from the low cylinders in filling "low" bottles - - - - - - - - - - - - - - - _____

(120) Why is only one large cylinder opened at a time?
Because the large cylinders would all equalize in pressure if all three were opened at once - - - - - _____

(121) How can you tell the pressure in the large cylinders while attached to pump? - By opening the cylinder valve and reading upper gage - - - - - - - - - - - _____

(122) How can you tell how full the apparatus bottle is while filling? - By reading lower gage with apparatus bottle valve open - - - - - - - - - - - - _____

(123) What is used for lubricant? - ¼ glycerine and ¾ water - _____

(124) Why not use oil? - Compressed oxygen with oil will cause an explosion - - - - - - - - - - - - - - - - _____

(125) Crew member will be taken to pump and indicate how he would fill an empty apparatus bottle from three cylinders with pressure of 50 Atms. 90 Atms. 120 Atms. _____

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Gas Masks

(126) Indicate how worn

(127) How put into service - Test for leaks by placing hand over intake opening at bottom - - - - - - - - -

(128) Note gage on air indicator - - - - - - - - - - - - -

(129) Remove stopper from bottom of canistor - - - - - -

(130) What gases will it protect you from?
Carbon monoxide
Ammonia
Illuminating Gas
Smoke
Timber gases -

(131) Weight? - 5¾ lbs. - - - - - - - - - - - - - - - -

(132) How long will it serve? - For two hours or more, depending on how much gas it has to absorb - - - -

(133) Does the use have to be continuous? - No, it can be worn intermittently for one year, provided it is kept stopped when not in use or is not used in excessively moist air - - - - - - - - - - - - - - -

(134) How can you tell when the canister is boginning to fail? - By its getting noticeably warm - - - - -

(135) Should it be warm when the oxygen content of air is very low? - No - - - - - - - - - - - - - - -

(136) How low does the oxygen content of air in a metal mine have to be for danger in wearing gas masks? - Oxygen too low for a candle or carbide lamp to burn freely - - - - - - - - - - - - - -

(137) Should crews wearing gas masks be equipped with flashlamps only? - No, should have flashlamps and carbide lamps or lighted candles - - - - - - -

(138) Where stored on rescue truck? - Six with extra canister are stored in long cupboard at top of left side of truck at rear - - - - - - - - - - -

Self-Rescuers (Carbon Monoxide)

(139 How carried on apparatus? - Snapped to right side at waistline - - - - - - - - - - - - - - - - - - -

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(140) How opened? - Tear off the flat side that snap is fastened to - - -

(154) How refilled? - Unscrew cap and fill with liquid pyrene - - -

(164) How is it read? 3 In feet per minute - - - - - - _____

(165) How is volume calculated? - By multiplying area at place reading was taken by the velocity per minute - _____
(Have crew member read anemometer)

(166) If water gage was required, how could it be determined? - By connecting one end of U tube to hole in stopping and reading difference in height of water in the U tube - - - - - - - - - - - - - - - _____
(Have crew member read a water gage)

(167) How much air would an entombed man require each 24 hours? - If he remains at rest 400 cubic feet (1 cubic foot = 28.32 liters) - - - - - - - - - - - - _____

(168) If he works some? - Laboring some he would require double that amount or 800 cu. ft. - - - - - - _____

Walking at the rate of 2 miles per hour a man needs about double the amount of air required while at rest
Walking at the rate of 4 miles per hour a man needs about 4 times the amount of air required while at rest.

(169) Demonstrate how to use monoxide detector - - - - _____

(170) How many times should bulb be squeezed? - Ten - _____

(171) Suppose tube showed very blue at first squeeze? (High CO and unsafe to remain without apparatus) _____

Miscellaneous Accessory Equipment

(172) Telephone

How many field telephones have we? - Three - - _____

How much wire on reels? - 3,000 feet - - - - - _____

(173) How operated to call and talk? - Ring by turning crank and push button in on hand piece to talk and hear (demonstrate) - - - - - - - - - - - - - - - - _____

(174) Can one phone be used while it is being moved? Yes, if attached to "contact" reel one phone can be used - _____

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Pipe connections

(175) Cellar nozzles.

How many do we have? - Two - - - - - - - - - - -
How many openings on each? - 9 and 4 - - - - - - _____

(176) What size pipe do they fit? - 1 and 2½ inch - - -
Can size of pipes serving them vary? Yes, by using
bushings or reducers - - - - - - - - - - - - - - - - _____

Geophone

(177) For what is it used? - To hear sounds through the
ground - _____

(178) Can direction of sound be determined by use of
geophone? - Yes - - - - - - - - - - - - - - - - - - _____

(179) Where stored on truck? - In long cupboard at top
of body at rear on right side - - - - - - - - - - - _____

(180) What is the pyrotannic detector used for?
To determine the per cent of carbon monoxide the
blood has absorbed - - - - - - - - - - - - - - - - - _____

(181) Can the blood of a dead person be tested? - Yes _____

(182) What electric current will our two fans operate on?
One, 110V, 220V, 400V. A.C.
Other 220V. D.C. - - - - - - - - - - - - - - - - - - _____

(183) What gages of track will they run over?
18, 24, 30, and 36 inch gage - - - - - - - - - - - _____

(184) What track gage will serve the crew member's mine? _____

(185) What fan will serve the crew member's mine? - - - - _____

Old Dominion. The D.C. everywhere (460 r.p.m.)
and the A.C. (330 r.p.m.) on 18 station and the
18 W. and 2012 winzes.

Arizona Commercial M.Co. 220 A.C. (335 r.p.m.)

Iron Cap C.Co. (110 A.C. - 350 r.p.m.) Lighting circuit
(440 A.C. - 490 r.p.m.) Shaft and station
(110 A.C. - 520 r.p.m.) Surface

Miami Copper Co. 220 D.C. - 477 r.p.m.

Inspiration C.C.Co 440 A.C. - 510 r.p.m.

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(186) Have you read a copy of the instructions in case of fire at your mine? - - - - - - - - - - - - - - - - - - _____

If crew member has not, furnish him with copy to read. After reading credit him with "Yes". (The answer to this must be "Yes."

Precautions around Apparatus

(1) Be careful of leaks in apparatus.

(2) Be sure of full cylinder of oxygen.

(3) Be sure of freshness of regenerator charge.

(4) Keep all open lights (carbide lamps, etc.) away from apparatus while assembling and especially while wearing.

(5) Never let the members of a 5-man crew become separated.

(6) Always use life line even though air is clear when entering.

(7) Use "blind" man's sticks when entering heavy smoke.

(8) Do not travel in places except where agreed upon when entering.

(9) Never climb up or down raises without orders and then all possible precautions will be taken, such as posting a reserve crew at the entrance to the raise and another reserve crew at fresh air base.

(10) When the by-pass is used several times in a few minutes by one or more members of the party, it should be investigated, if nothing is found wrong the pace should be reduced.

(11) No crew member should be alone on a cage deck.

(187) How many of the above suggested precautions can the crew member relate? - - - - - - - - - - - - - - - - - - _____

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